(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 555 190 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **93830042.3**

(22) Date of filing: **05.02.93**

(51) Int. Cl.⁵: **B26D 3/16,** B26D 5/22, B26D 7/12

(30) Priority: **07.02.92 IT FI920030**

(43) Date of publication of application: **11.08.93 Bulletin 93/32**

(84) Designated Contracting States: **AT DE ES GB GR NL**

(71) Applicant: **FABIO PERINI S.p.A.**
Via per Mugnano
I-55100 Lucca (IT)

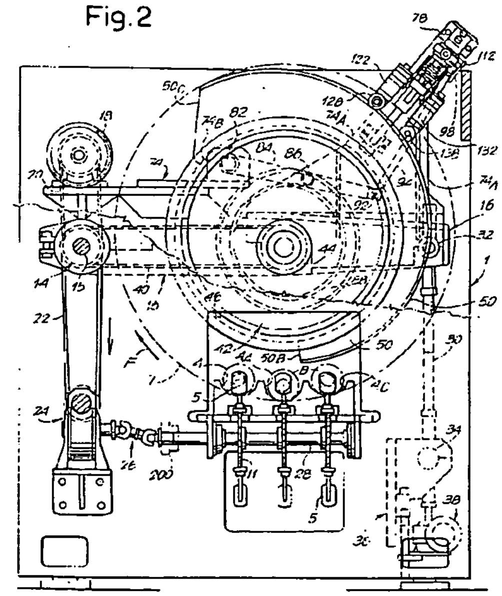
(72) Inventor: **Biagiotti, Guglielmo**
Via di Vorno n.105
I-55012 Capannori, Lucca (IT)

(74) Representative: **Mannucci, Gianfranco, Dott.-Ing. et al**
Ufficio Tecnico Ing. A. Mannucci Via della Scala 4
I-50123 Firenze (IT)

(54) **Method and machine for cutting rolls of paper and the like.**

(57) The blade (50) has a helicoidal shape with an external cutting edge (50A) having increasing radius and developing over a partial sector, the difference between maximum and minimum radius being at least equal to the maximum diameter of the rolls or logs (B) to be cut. The shaft (45) and the axis of rotation of the blade rotor (42) are not displaced during the rotor's revolution and are slightly inclined with respect to the direction of advancement of the logs within their carriers. Thus the cut performed on the rolls (B) and the cutting edge (50A) will, on the average, be perpendicular to the axes of the rolls (B). The advancement of the roll(s) (B) in the carriers is continuous and the cutting takes place during a portion of each revolution of the rotor and during that portion of the roll's advancement which corresponds to the axial length of the small rolls to be produced.

Fig.2



EP 0 555 190 A2

BACKGROUND OF THE INVENTION

The most widespread cutting machines for the formation of small rolls of paper - of the type including toilet paper, all-purpose wipers and other - are provided with a discoidal, high-speed rotating blade. The axis of rotation of the blade is in turn provided with a motion which may be either a reciprocating motion in a direction perpendicular to the log feeding motion, or it may rotate about an axis parallel to the log feeding motion. Whatever the type of the blade axis motion, it has the purpose of moving the blade in and out of the product to be cut, so that when the blade is clear of the product to be cut, the latter is able to advance to an extent corresponding to the desired length to which the small roll is to be cut. The frequency of the cyclic movements of both the cutting element and the product feeding systems, which is equal to the production rate of the small rolls, gives rise to obvious qualitative and quantitative drawbacks and limitations in the production.

DESCRIPTION OF THE INVENTION

These and other drawbacks are overcome by the cutting machine of the present invention, which is provided for cutting small rolls of toilet-paper or the like from rolls or logs of considerable length, said machine comprising sliding seats or carriers and means for feeding one or more logs to be cut, and a rotor with a blade. More specifically, according to the invention, the blade has a helicoidal conical shape with external cutting edge having radii which change over a portion of a revolution (or even a complete revolution). The difference between the maximum and minimum radii of the cutting edge is at least equal to the maximum diameter of the rolls or logs to be cut. The rotating shaft and the blade rotor are not displaced during the rotor's revolution, and are slightly inclined with respect to the direction of sliding of the logs in their seats or carriers. Thus the cut performed on the logs by the cutting edge of the cutting blade will, on the average, be perpendicular to the axes of the logs. The advancement of the log(s) (B) in the carriers is continuous and the cutting takes place during a portion of a revolution of the rotor and during that portion of the log's advancement which corresponds to the axial length of the small rolls to be produced.

The blade sharpening means may comprise a cyclically movable unit (i.e. movable upon every revolution of the blade rotor) which moves both radially and axially with respect to said blade. The system for the advancement of the grinding wheels towards the blade may be obtained in two different ways: either moving the carriage of the grinding wheels towards the rotor axis, or moving the blade within its seat towards the grinding wheels.

The present cutting machine includes (similarly to the traditional cutting machines) two-part clamps which grip the logs and which are located both upstream and downstream of the cutting area. Said clamps elastically exert a constant, adjustable and not necessarily high pressure onto the material of each log in order to cause a continuous forward advancement of the log. The clamps, in this case, are only intended to grip the roll or log during the cutting action so as to counteract the transverse thrust caused by the blade.

Owing to the successive sharpenings, the blade dimensions are reduced. To compensate for this wear and to ensure the complete cutting of rolls or logs, the machine is provided with a system allowing the blade and rotor axis to move close to the sliding cradles of the rolls or logs.

With the above and other objects in view, more information and a better understanding of the present invention may be achieved by reference to the following detailed description.

DETAILED DESCRIPTION

For the purpose of illustrating the invention, there is shown in the accompanying drawings a form thereof which is at present preferred, although it is to be understood that the several instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

In the drawings, wherein like reference characters indicate like parts:

FIG. 1 shows a schematic plan view.

FIG. 2 shows a schematic front view on line II-II of Fig. 1

FIG. 3 shows a partial side view on line III-III of Fig. 1

FIGS. 4 and 5 show two partial and enlarged views of Fig. 1 and Fig. 2.

FIG. 6 shows a sectional partial view of the blade rotor

FIGS. 7, 8 and 9 show in side and front views a set of "clamps" to support the rolls or logs in the cutting region.

FIG. 10 shows a first embodiment of the system for periodic sharpening of the blade.

FIG. 11 is a schematic view on line XI-XI of Fig. 10.

FIGS. 12, 13, 14 and 15 show enlarged details of parts of the assembly of Fig. 10.

FIG. 16 diagrammatically shows the comparison between the first and the second embodiment of the sharpening system.

FIGS. 17 and 18 schematically show an axial view and a side view of the machine with the second embodiment of the sharpening system; and

FIG. 19 shows an exemplary section view ac-

cording to portions of planes perpendicular to that of Fig. 17.

Referring now to Figs. 1 to 6, numeral 1 indicates the cutting area of a log-saw with a structure (3) attached thereto for holding the cradles or seats which slidingly carry the logs to be cut. The cradles in this case are three, designated 4, 4A and 4C, but there may be more or less, as desired. Acting along said seats are chain pushers or any other type of pushers provided with a continuous flexible member, which include thrust elements (5) engaged along chains (7) driven between chain wheels (9) and (11) (or pulleys for a toothed chain) so as to cause the pushers (5) to slide along cradles such as those indicated by (4), (4A), (4C).

Mounted on the housing (with ball bearings, not shown) is a sleeve (14) whose axis is slightly inclined with respect to the roll feeding direction defined by the sliding cradles. This sleeve lies in a plane which is parallel to the plane in which the two other sliding cradles (4 and 4C) lie. Cradles (4) and (4C) are arranged slightly higher than the sliding cradle (4A). Supported within sleeve (14) is a main shaft (15). Mounted on the sleeve (14) are: 1) a unit (16) which is able to oscillate about the axis of the sleeve (14) and which carries the cutting tool to be described hereinafter; 2) a motor (18); and 3) the complete blade-sharpening group to be described later on. A belt drive (20) connects the motor (18) to the shaft (15). A belt drive (22), arranged outside the housing (1), transmits the motion of the shaft (15) to a reduction gear (24). The latter transmits, via a universal joint (26), a reduced but continuous motion, (derived from the motor (18) as above described) to a shaft (28) on which the chain pulleys or wheels (11) are mounted for moving the pushers (5).

The unit (16), oscillating around the common axis of sleeve (14) and shaft (15), is supported (on the side opposite the sleeve 14) by a rod (30) which is pivoted at (32) to the unit (16) and at (34) to a bracket (36) fixed to the main frame (1). Said rod (30) can be moved up and down by a screw-and-nut system operated by a motor-reducer (38) suitably calibrated for determining the angular displacement of the unit (16) to accommodate the extent of wear of the cutting blade, to be described later. This adjustment to the unit (16) (as a consequence of the action of the sharpening means to be described) ensures the sharpening of the cutting blade because the parts (30) to (38) control the slow, progressive lowering of the unit (16) around the axis of sleeve (14) and shaft (15).

A belt (40) connected to shaft (15) turns a rotor (42) whose hub (44) and extension (45) rotate about an axis concentric to that of shaft (15). It is carried by the unit (16) in a position between the pivot-point on the sleeve (14) and the pivot-point (32) of the rod (30). Attached to the flange of the hub (44) is a disk (46) at the periphery of which an annular ring (48) is engaged having a particular shape with a flange-like shoulder (48A) of helicoidal development. A flexible blade (50) is securely mounted against said flange-like shoulder (48A) and said blade (50) extends over a partial arc of the periphery of the flange-like shoulder (48A) (over an angular development of 180 degrees in the illustrated embodiment). A corresponding ring sector fixing ring (48B) cooperates with said blade (50) by tightening screws on the shoulder (48A). The blade (50) has an external cutting edge (50A) having a development with an almost linearly changing radius from a minimum to a maximum value between the two ends (50B) and (50C) of the blade. The blade (flat before mounting) assumes the helicoidal shape when it is clamped between the flange-like shoulder (48A) and the fixing ring (48B). The difference D (see Fig. 6) between the maximum radius and the minimum radius of the cutting edge (50A) corresponds to the maximum dimension of the diameter of the logs (B) to be cut by the cutting machine.

The end (50C) of maximum radius of blade (50) moves along a circular trajectory T. The trajectory T, in the lower stretch thereof, passes below the sections of the logs B which are in the cradles (4, 4A, 4C). The inclination of the axis of the rotor (42) (which is parallel to the axis of sleeve (14) and shaft (15)) is such that the chord of the blade helix, within the arc where it engages the logs B to be cut, is substantially perpendicular to the axes of the logs, i.e., to the axes of the cradles in which the logs are sliding. The geometrical condition mentioned above is approximate, but it does provide acceptable tolerances and sufficient accuracy for the cutting plane to be substantially perpendicular to the axes of the logs to be cut.

The direction of rotation of the rotor being that indicated by the arrow F, during each turn the external cutting edge (50A) of the blade (50) is active for about half a revolution, that is to say, for an arc which has an angular development corresponding to the cutting edge of the blade itself. Said cutting edge (50A) moves progressively down from the position of maximum distance from cradles (4, 4A, 4C) (which is that of the leading edge (50B) of the blade) until it passes beyond the bottom of the cradle (4), in the region of maximum radial dimension of the blade, i.e., in the terminal edge (50C) of said blade. During the fraction of revolution (in this case about a half turn) of the rotor, during which the blade (50) is cutting the logs, the said blade, because of its helical development, is displaced in the log-feeding direction, according to arrow fB (see Fig. 3). This displacement is equal to the fraction of pitch (generally about half a pitch) of the geometrical helix within which the cutting edge lies and, practically, of the helicoid within which the blade (50) lies.

The full pitch of the geometrical helix defined by the cutting edge (50A) corresponds to the axial dimension of the small rolls which are obtained by cut-

ting the logs B by means of the blade. During the active arc of the blade (slightly larger than 180 degrees in the drawing), the blade carries out the cutting of the logs in the three cradles (4, 4A, 4C) by advancing along with the logs which are pushed by the pushers (5). After having completed the active arc of the blade (50A), that is to say, after the blade end (50C) has come out of contact with the logs, said rolls or logs continue to move forward along the cradles, so that there are obtained the small rolls cut by the blade (50) which have an axial dimension which is equal to the pitch of the geometrical helix of the cutting edge (50A) and which is, in part, operated during the cutting by the blade (50) and, in part, (for slightly less than 180 degrees of the rotation of rotor (42)) while the blade is inoperative.

It will be appreciated that with the system described above there is provided continuous rotation of the rotor (42) of blade (50), as well as continuous advancement of logs B within the cradles (4) by means of the pushers (5). None of the members so far described has an alternate motion with a frequency equal to the rotation frequency of the blade. Some members (to be described later) which have relatively very limited masses are provided with a limited reciprocating motion with a frequency which corresponds to that of rotation of rotor (42). These members are, in particular, some of the members of the device for sharpening the blade (50), which device has to follow the cyclic variations of the radial dimension of the blade and of the helicoidal development of the cutting edge (50A). The progressive displacement carried out by the components (30) - (38), to move the axis of rotation of the rotor (42) progressively closer to the cradles (4), according to the blade wear, is an extremely slow, progressive and not reciprocating motion. As will be evident to those skilled in the art, the described arrangement allows obvious advantages in comparison with the traditional cutting machines having relatively high masses provided with reciprocating motion at the frequency of the cutting cycles.

According to an alternate embodiment, a system of cyclic variation of the advancement speed of the rolls during each revolution of the rotor (42) may be provided for increasing or decreasing the advancing speed during the step in which the blade (50) is inoperative. This may be achieved through a device shown in Fig. 2 by the dotted line (200) near the universal joint (26) on the transmission (15) to (28). Such device may be similar to that described in U.S. Patent Application Ser. No. 07/856,449, or in the corresponding E.P. Application No. 92830161.3, the contents of which are incorporated herein. The axial dimension of the small rolls is increased by an acceleration and decreased by a deceleration.

As already noted, the logs within cradles (4, 4A, 4C) move forward with continuous motion (and possibly with cyclic variations). At the cutting area where the blade (50) works, there is the need of a lateral, i.e., a peripherical support for the log, in order to support the material during the cutting operation. This is usually provided for by so-called "clamps" which, in the prior art machines, cyclically cause a temporary pressure on the log when the log is stopped to carry out the cut, and which are released to allow for the intermittent advancement of the log. In the cutting machine according to the present invention, wherein the logs continue to move during the cutting operation, pressers are provided which act continuously to provide lateral restraint, but which allow sliding of the logs because there is very little friction between the external surface of the log and the concave surface of the active parts of the pressers. According to what is shown in Figs. 3, 7 and 8, along each cradle (4, 4A, 4C) two elements (54) and (56) are provided whose concave surface is turned towards arrow F which indicates the movement of blade (50). Accordingly, the log, which is urged in the direction of arrow F by the blade during cutting, steadily abuts against the concave surfaces of said elements (54) and (56). Further elements (54A) and (56A), substantially facing those indicated by (54) and (56) and symmetrically disposed with respect to the axis of the log cradles, are resiliently biased so as to exert a relatively limited and adjustable pressure on the advancing logs thereby allowing the continuous advancement of the material. It is thus possible to keep the material sufficiently supported in the cutting area and to provide a "clean" cut on a material which is sufficiently sustained and properly supported as described. The elements 54A and 56A are supported by rocker members (58) which are substantially T-shaped and articulated at (60) to fixed points of the housing 1, and further articulated at (62) to a bar (64) which is pushed in the direction of arrow F64 by a spring or, preferably, by a pneumatic cylinder-piston spring (66) which reacts on a stem (68) engaged at (70) to the fixed structure of frame 1. This arrangement, as well as a variation of the pneumatic pressure, makes it possible to adjust the resilient thrust of the movable elements (54A) and (56A) in order to control the switch pressure on the logs to allow for their continuous sliding. This arrangement of resilient yielding elements (54A) and (56A) allows also to match variations in the diameter of the logs fed to the cutting machine, at least within certain limits of tolerance. The elements (54, 56, 54A, 56A) have flared or "funnel"-shaped edges facing the incoming material, and have rear ends tapered or shaped to accommodate the blade during the cutting.

A system will now be described which ensures at all times a proper sharpening of the cutting edge (50A) of blade (50).

The sharpening system must be provided with cyclic radial motion which accommodates the variations of the radius of the cutting edge (50A), and with a cyclic axial motion which follows the helicoidal shape of

the cutting edge (50A). Each of these two cyclic motions, which are synchronous, must be carried out during each revolution of the rotor (42). Each revolution must have an active phase while the cutting edge (50A) slides in front of the sharpening system, and a return phase synchronised with the arc without cutting edge. The sharpening system must adjust progressively during the life of the blade, to compensate for the wear of the blade and maintain the sharpening thereof.

As shown in particular in Figs. 5 and 10 to 15, a support (74) is fixed on the unit 16 which oscillates on the sleeve (14). Two guides (80) are fixed on the extension (74A) of said support by means of blocks (76), (78), the guides lying in a radial plane passing through the axis of rotor (42) and shaft (45). Said guides (80) also lie in a plane inclined with respect to a plane perpendicular to the axis of rotation of the rotor (42). This inclination actually corresponds to the inclination of the straight line LR (see Fig. 10) grazing the ends (50B) and (50C) of blade (50) when these ends are in their closest position to guides (80).

Mounted on the support (74), and in particular on bracket (74B) (see Fig. 4) is a pin (82), the axis of which is parallel to that of shaft (45) and on which a lever arm (84) can oscillate. A dual tappet roller (86) is fastened to said arm (84), and it has two coaxial rollers which operate between the two flanks of a channel cam (88), the two flanks of different height of said channel (88) (see Figs. 3 and 4). The channel (88) is formed in a discoidal body (90) which is fixed to the blade rotor (42). The channel cam (88) is annularly developed so that, with the rotation of the rotor (42) of blade (50), the lever arm (84) may oscillate under the control of the channel cam (88). The movable end of the lever arm (84) engages, through a ball-joint articulation generally shown at (92), a tie-strut rod (94) having the function indicated below. Slidingly mounted on the guides (80) is a slide (96) which may be driven into reciprocating motion along the guides (80) by the tie-strut rod (94) which, at the end opposite the ball-joint (92) is another ball-joint (98) connected to the slide (96). The ball joints (92), (98) allow the reciprocating operation of the slide (96) by means of the lever arm (84) even though the guides (80) are inclined as set forth above.

The slide (96) supports, throgh an extension (96A), two parallel guides (100), (102). The guide (100) is cylindrical and fixed, while the guide (102) is a guide-shaft able to rotate within ball bearings (104), but not move axial displacements, and is provided with a threaded section (102A). Sliding on guides (100) and (102) is a skid (106) which is capable of movement along the guides (100) and (102) in a direction which is kept substantially at right angle to the axis of rotor (42) and shaft (45). The skid (106) carries, in the manner indicated hereinafter, the grinding wheels for sharpening the blade (50). Said skid (106), which, along with the grinding wheels is coordinated with the reciprocating motion of slide (96), must be progressively and slowly moved closer to the rotor to accommodate the progressive wear of the blade (50), to ensure the correct sharpening of the cutting edge (50A) of the blade. The slide (96) is driven at a frequency corresponding to that of rotation of the rotor (42), with reciprocating displacements LR (see Figs. 10 and 13) along the guides (80) in order to follow, during each revolution, the radial and axial variation of the shape of the cutting edge (50A) of blade (50). Simultaneously, the grinding wheels, which are carried by the skid (106), must be progressively and slowly displaced with respect to the slide (96) to the extent necessary to compensate for the progressive wear of blade (50). Said progressive advancement of the skid (106) is determined by the screw-like coupling of the threaded part (102A) of cyclindrical shaft-like guide (102) with a corresponding nut (106A) of skid (106), and by the rotation of said guide (102).

Mounted on this rotating cylindrical and threaded shaft-like guide (102), is a unidirectional (free-wheel) connection between said shaft and a rocker lever (110) oscillating with reciprocating motion about the axis of said guide shaft (102). The rocker lever (110) is moved with reciprocating oscillation movements about the axis of the guide-shaft (102) by a preferably pneumatic cylinder-piston system (112), and with a frequency depending on the extent of the blade wear. This ensures, by a positive control in the two directions or by an elastic reaction control, the periodic oscillation over limited arcs of the rocker lever (110). The latter forms, together with a central member (113) carried by the guide-shaft (102), a free wheel system which includes a unidirectional elastic driving member (110A). This unidirectional coupling system (110), (110A), (113), makes it possible to achieve a slow, intermittent rotation of the guideshaft (102) and thereby a slow advancement of the skid (106) in the direction of arrow (F106) during a life cycle of a blade, and the return of same skid back to the starting position (spaced from the cutting edge of the blade) upon the replacement of the worn out blade with a new one.

The skid (106) carries a pin (116) protruding from opposite sides of said skid, to support two grinding wheel-holder units (118), (120) which are cantilever-developed and capable of being adjusted in angular position on the pin (116). Their relative angular position may be observed through respective index systems (118A), (120A), which cooperate with relevant angular scales (106A), (106B) borne by the skid (106).

On the grinding wheels-holder unit (118) and, in particular, on its cantilever projecting parts, there are two leaf springs (122) connected to a grinding wheel support (124). A cylinderpiston system (126) (see Fig. 12) operates between the grinding wheel-holder unit (118) and the grinding wheel support (124), thereby

causing said grinding wheel support (124) to move parallel to itself, owing to the flexibility of the leaf springs (122). This grinding wheel support (124) carries a motor (127) whose projecting shaft drives the grinding wheel (128), the grinding wheel having an inclination depending on the angular setting of the grinding wheels-holder unit (118) on the shaft (116), said setting being controlled by the index (118A).

Another grinding wheel-holder unit (120) (which is oriented at an angle opposite to the members supported by the grinding wheels-holder unit (118)) is similar to the grinding wheels-holder unit (118) described above, with leaf springs (132) which carry a grinding wheel support (134) designed to be controlled by a cylinder-piston system (136). Said grinding wheel support (134) is provided with a motor (137) of its own, which drives the relevant grinding wheel (138), the latter being offset with respect to the one indicated by (128) and inclined in opposite direction thereto, wtih respect to the plane of the blade (50) to be sharpened.

The arrangement of the skid (106) and all that is connected thereto, makes it possible accurately to position the grinding wheels (128) and (138) at a given inclination, and to resiliently urge them by means of the leaf springs (122) and (132) and of the cylinder-piston systems (126) and (136) against the cutting edge (50A) of blade (50). This causes the grinding wheels to follow the cyclic variation of the radius of the cutting edge (50A) of blade (50) by virtue of the reciprocating motion of slide (96) at every revolution of rotor (42). It also causes the grinding wheels to move forward in a substantially radial direction shown by arrow F106 according to the blade wear with an intermittent feeding rate as determined by the cylinder-piston system (112) which rotates the guide-shaft (102), and thus causes the slow advancement through the screw coupling of the skid (106). The replacement of the blade is accompanied by a fast return of the wear-compensating system to the original position. The grinding wheels follow the blade as they are operated in a reciprocating fashion owing to the alternate motion of the slide (96) along the guides (80) and owing to the inclination of such guides (80), which makes it possible to follow the helicoidal shape of the blade as well as the radial variation of the blade during each revolution.

Shown in Figures 16 to 19 is a second and different embodiment of the sharpening system. In the embodiment shown in Figs. 10 to 14, the grinding wheels (128) and (138) are carried by the skid (106) which is progressively and radially brought close to the axis of rotor (42), by means of the guides (100) and (102) and of drive (110), (112), (113) acting on the guide (102) which is threaded at (102A), to cause the skid to advance in the direction of arrow (F106). According to the embodiment shown in Figs. 16 to 19, a relative angular or "tangential" advancement of a blade (350) (corresponding to blade (50)) is imposed with respect to the cam (corresponding to cam (88)) which operates the reciprocating motion of the slide (96). In practice, by considering the diagrams of Fig. 16, which shows the linear development of the arcuated blades in the diagram A (corresponding to the solution of Figs. 10 to 14), provision is made for the grinding wheels (128), (138) to perform, not only the reciprocating motion caused by slide (96), but also the advancement according to arrow F106 with respect to the blade (50). In the diagram B, the grinding wheels (428), (438) do not advance gradually, and correspond only to the reciprocating motion of the slide (396) along the guides (80). It is the blade (350) which moves forward gradually in the direction of arrow F406 with an angular movement relative to rotor (42) to which the channel cam (88) is fixed.

In the Figs. 17 to 19, the members corresponding to those already described are designated by the same reference numbers increased by "300". The members (348), (348B) which engage the blade (350), are part of a discoidal core which also includes a centrally bored disk (246). The inner edge (246A) of the disk (246) is slidingly engaged within a channel (250) formed between the discoidal body (90) of the channel cam (88), the hub (344) and a side member (252) fixed like the body (90) to the periphery of the hub (344). In this way, the unit (246), (348), (348B) may be angularly displaced within the channel (250) with respect to the cam (88) which drives the slide (396) into a reciprocating motion. Rotatively mounted on the hub (344) is a bush (211) which is movable about its axis which is parallel to, but offset from, the axis of rotor (42). Threadedly engaged within a diametrally extending threaded hole (213) of bush (211) is a threaded rod (215). This rod (215) is rotatively connected through an articulated joint (217) to a shaft (219) mounted through roll bearings on a support (221) which is carried by unit (246), (348), (348B) of blade (350). A device (223) is able to drive into a slow and intermittent rotation the shaft (219) and thus the threaded rod (215). This device (223) is not described in detail as it can be constructed exactly like the device (110), (112), (113), (110A) which drives the guide-shaft (102), (102A) in the same way as described in the previous embodiment. A duct for compressed air will be arranged to include a joint rotating, for example, inside the axial hole of the rotor (42) and its shaft, to lead into the pneumatic actuator of device (223). The threaded rod (215), therefore, causes a gradual angular sliding of the group (348), (348B), (246), (246A) of blade (350) with respect to hub (344) and cam (90), (88), thereby determining an angular movement of the cutting edge (350A) of blade (350) in the direction of arrow F406 with respect to the sharpening wheels.

In this second embodiment, the following members are omitted from slide (96): actuator device

(112), (110), (113), (110A); guide-shafts (100) and (102), (102A) and skid (106). As can be seen in Fig. 17, the same slide (396) carries the pin (416) for the two grinding wheels-holder units (418) and (420). Moreover, in this second embodiment, there is no longer need to progressively move the axis of rotor (42), (344) close to the roll or log cradles (4), (4A), (4C) and to the clamps, since the cutting edge (350A) of the blade (350) does not change its distance from the axis of rotation due to wear and sharpenings, but it actually changes only to a little extent its own angular position. The variations take place according to arrow F406 (see Fig. 16B) (i.e. tangentially) and not according to arrow F106 (i.e. radially) (see Fig. 16A) as in the first solution of the sharpening device. Accordingly, the arm (16) needs no longer to be moved about the axis of shaft (15) and sleeve (14), and the related members (32), (30), (34), (38), (36) are not required. The arm (16) can be replaced with a lever (116) of a portal-like structure, a column 116A of which replaces the adjustable support (32), (30), (34), (38), (36).

It is understood that the drawing shows an exemplification given only as a practical demonstration of the invention, as this may vary in the forms and dispositions without nevertheless coming out from the scope of the idea on which the same invention is based. The possible presence of reference numbers in the appended claims has the purpose to facilitate the reading of the claims, reference being made to the description and the drawing, and does not limit the scope of the protection represented by the claims.

Claims

Claim 1: Rotary-blade cutting machine for cutting small rolls of toilet paper or the like from rolls or logs (B) of considerable length, comprising slide cradles and feeding means for one or more logs to be cut, and a rotor with a blade, characterized in that:

- the blade (50; 350) has a helicoidal development with increasing radius, the difference between the maximum and minimum radius being at least equal to the maximum diameter of the rolls or logs (B);
- the shaft of rotation (44, 45, 344, 345) of the rotor (42) of the blade (50) is slightly inclined with respect to the direction of sliding of the logs within their cradles (4,4A,4C);
- whereby an active region of the blade cuts the small roll(s) substantially perpendicularly to the axes of the logs (B) while the log(s) (B) are continuously moving.

Claim 2: Cutting machine according to Claim 1, wherein the cutting edge of the blade (50; 350) develops over a partial sector, and cutting takes place during a fraction of a revolution of the rotor, and during a fraction of the log advancement which corresponds to the axial dimension of the small rolls to be produced.

Claim 3: Cutting machine according to Claim 1 including blade-sharpening means, characterized in that said means comprise a unit which is both radially and axially movable at each revolution of the blade rotor.

Claim 4: Cutting machine according to Claim 1 or 2, including clamps which act on each log both upstream and downstream of the cutting area, characterized in that:

- said clamps (56, 56A) are resiliently urged to press against each log with constant and sufficiently limited pressure to allow for the continuous advancement of the log, and
- the adjacent edges of said clamps are so shaped as to accommodate the blade during cutting action thereof.

Claim 5: Cutting machine according to Claims 1 or 2, characterized in that the rotor (42) of the blade includes a discoidal core (46, 48; 246, 348) with a shoulder flange having helicoidal development, against which the flexible blade (50-350) is tightened by means of a ring (48B-348B) which has a complementary development,

- said blade having an external profile of conical spiral shape, i.e., of variable radius, and extending over a portion of revolution,
- the difference (D) between the maximum and the minimum radius being at least equal to or greater than the maximum diametral dimension of the rolls or logs (B) to be cut, and
- the tightening of the blade causing the latter to assume a substantially helicoidal shape.

Claim 6: Cutting machine according to Claim 1, characterized in that it comprises a single motor (18) with transmissions for the rotation of the blade rotor (42) and for the advancement of the pushers (7, 5) of the logs (B) within the cradles (4, 4A, 4c).

Claim 7: Cutting machine according to Claim 2 characterized in that it comprises a single motor (18) with transmissions for the rotation of the blade rotor (42) and for the advancement of the pushers (7, 5) of the logs (B) within the cradles (4, 4A, 4C).

Claim 8: Cutting machine according to Claim 6 characterized in that the transmission (22, 24, 26, 28) comprises a device (200) for accelerating or slowing down the feeding motion of the pusher during the inoperative step of the blade (50) at each revolution thereof, so as to change the distance between successive cuts.

Claim 9: Cutting machine according to Claim 7 characterized in that the transmission (22, 24, 26, 28) comprises a device (200) for accelerating or slowing down the feeding motion of the pusher during the inoperative step of the blade (50) at each revolution thereof, so as to change the distance between successive cuts.

Claim 10: Cutting machine according to Claim 3

characterized in that it comprises, on a unit (26) of the rotor (42) of the blade, guides (80) oriented towards the axis of rotation of the rotor (42) and inclined with respect to a plane perpendicular to said axis so as to result parallel to a straight line (RL) grazing the trajectory of the points of maximum radius (50C) and of minimum radius (50B) of the cutting edge of the blade in the region of said guides (80),

- a slide (96) reciprocating on said guides (80) at the same frequency of and in synchronism with the rotation of the rotor (42) of the blade, and
- grinding wheels (128, 138) on said slide (96) for sharpening the helicoidal cutting edge of the blade.

Claim 11: Cutting machine according to Claim 10 characterized in that it comprises on the rotor a prefereably channel-shaped annular cam (88) which extends around the axis of rotation, and on said unit (16) an articulation (84, 92, 94, 98) with a tappet (86) actuated by said cam (88) to drive the slide (96) for the grinding wheels.

Claim 12: Cutting machine according to Claim 10 characterized in that it includes on said slide (96),

- guides (100; 102) substantially oriented in a radial direction relative to the rotor (42) of blade (50),
- on said guides (100; 102) a skid (106) swingingly carrying the grinding wheels (128; 138) with relevant motorizations (127; 137) and elastic suspensions (122, 126; 132, 136);
- and a system (112; 110; 113; 102A; 106A) for the slow advancement of the skid (106) of the grinding wheels on said guides (100; 102) of the slide (96), to gradually move the grinding wheels (128; 138) close to the axis of the rotor (42) according to the wear of the blade (50) due to the sharpening.

Claim 13: Cutting machine according to Claim 12 characterized in that the unit (16) of the rotor (42) of blade (50) is movable toward the cradle(s) (4, 4A, 4C) of the rolls or logs to be cut, and that means (30, 38) are provided for slowly moving said unit according to the progressive wear of the blade.

Claim 14: Cutting machine according to Claim 13 characterized in that said unit (16) is angularly movable by said displacement means (30, 38).

Claim 15: Cutting machine according to Claim 11 characterized in that the discoidal core (246, 348) of the blade (350) is angularly movable about the axis of the rotor (42) with respect to the rotor (42) and the annular cam (88), and that a screw device (215, 211, 221) with actuator (223) acts between the rotor (42) and said core (246, 348) to cause a "tangential" advancement (in the direction of arrow F406) of the cutting edge (350A) of the blade with respect to the grinding wheels.

Claim 16: Cutting machine according to Claim 15 characterized in that the unit of the rotor (42) includes a structure (116, 116A) fixed to the housing (1).

Claim 17: Cutting method for logs of paper (B) and for other uses, including the advancement of the log (B) to carry out successive cuts thereon by a rotating blade, characterized in that it includes a conical helix-shaped blade rotating about a fixed or substantially fixed axis without cyclic translation motion.

Claim 18: Method according to Claim 17 characterized in that the axis of rotation of the blade is slightly inclined with respect to the direction of advancement of a roll.

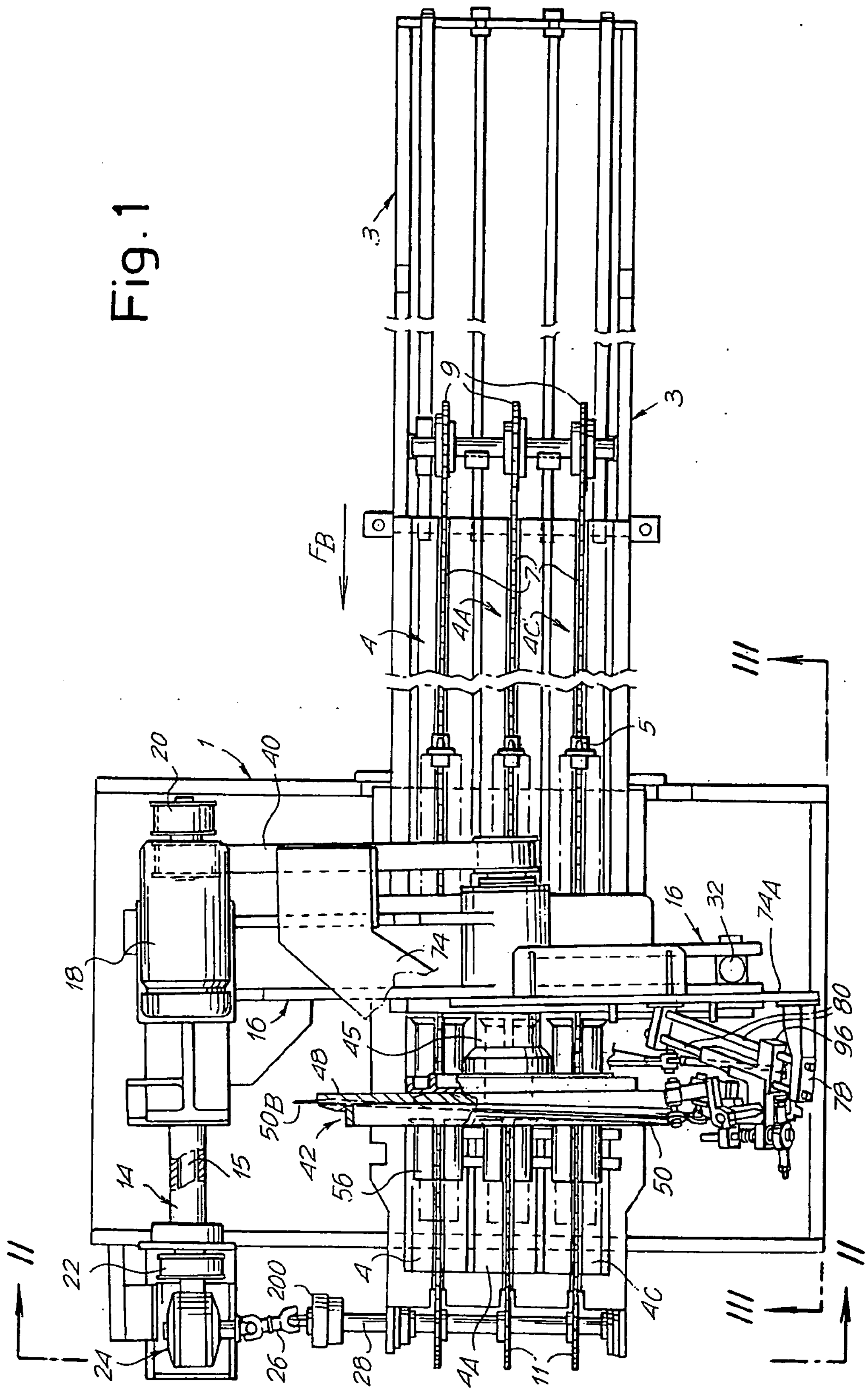

3
3
9
FB
7
4
4A
4C
5
1
20
40
18
16
74
16
32
7A
80
96
7B
45
48
50B
42
56
50
15
14
II
II
22
4
200
24
26
28
4A
11
4C
III
III

Fig. 1

Fig. 2

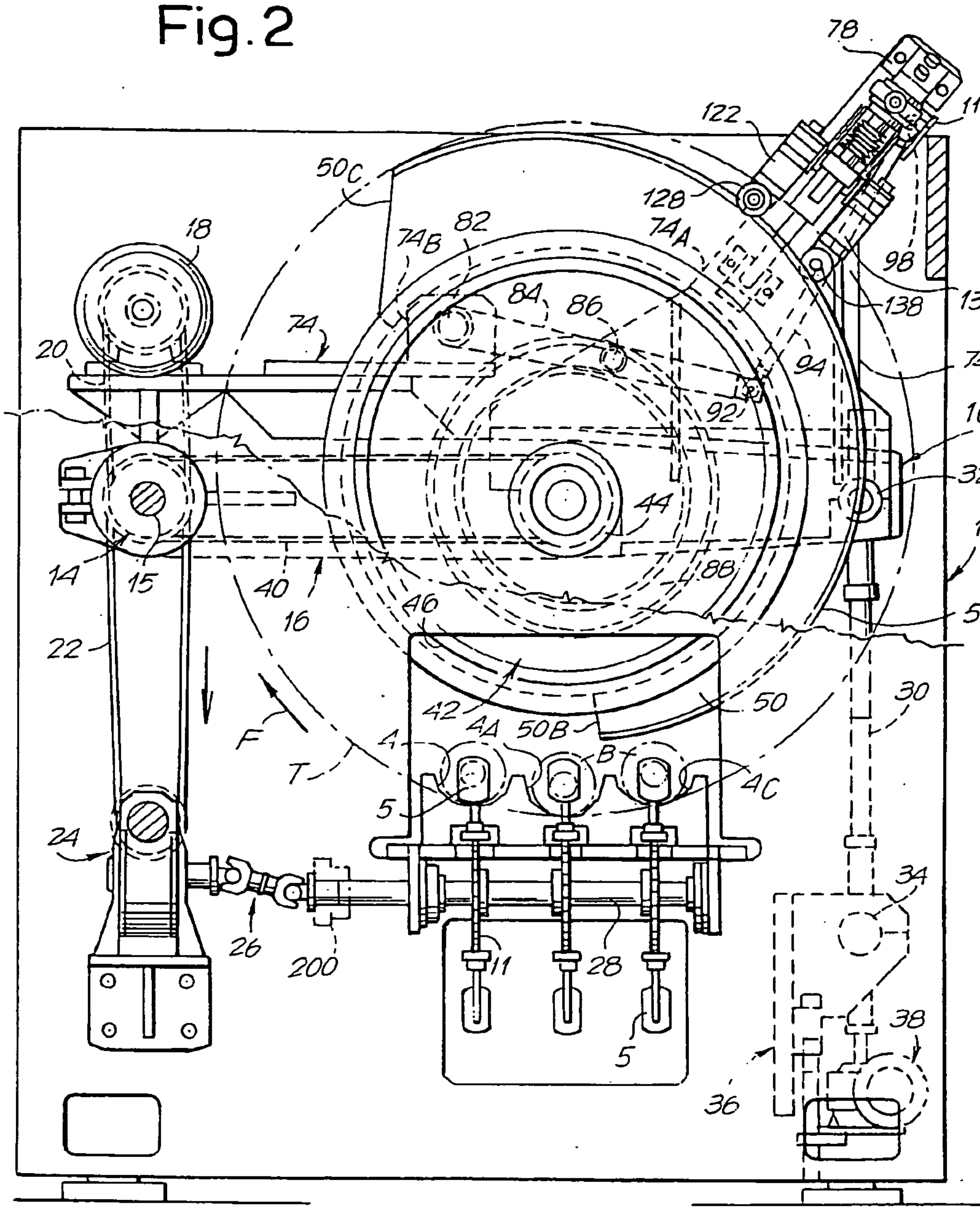

78
122
112
50C
128
74A
98
18
74B
82
132
84
86
138
74
20
94
74A
92
16
32
44
14
15
40
16
88
1
50
46
16
22
42
50
30
F
4A
50B
T
4
B
4C
5
34
24
26
200
11
28
38
5
36

Fig.3

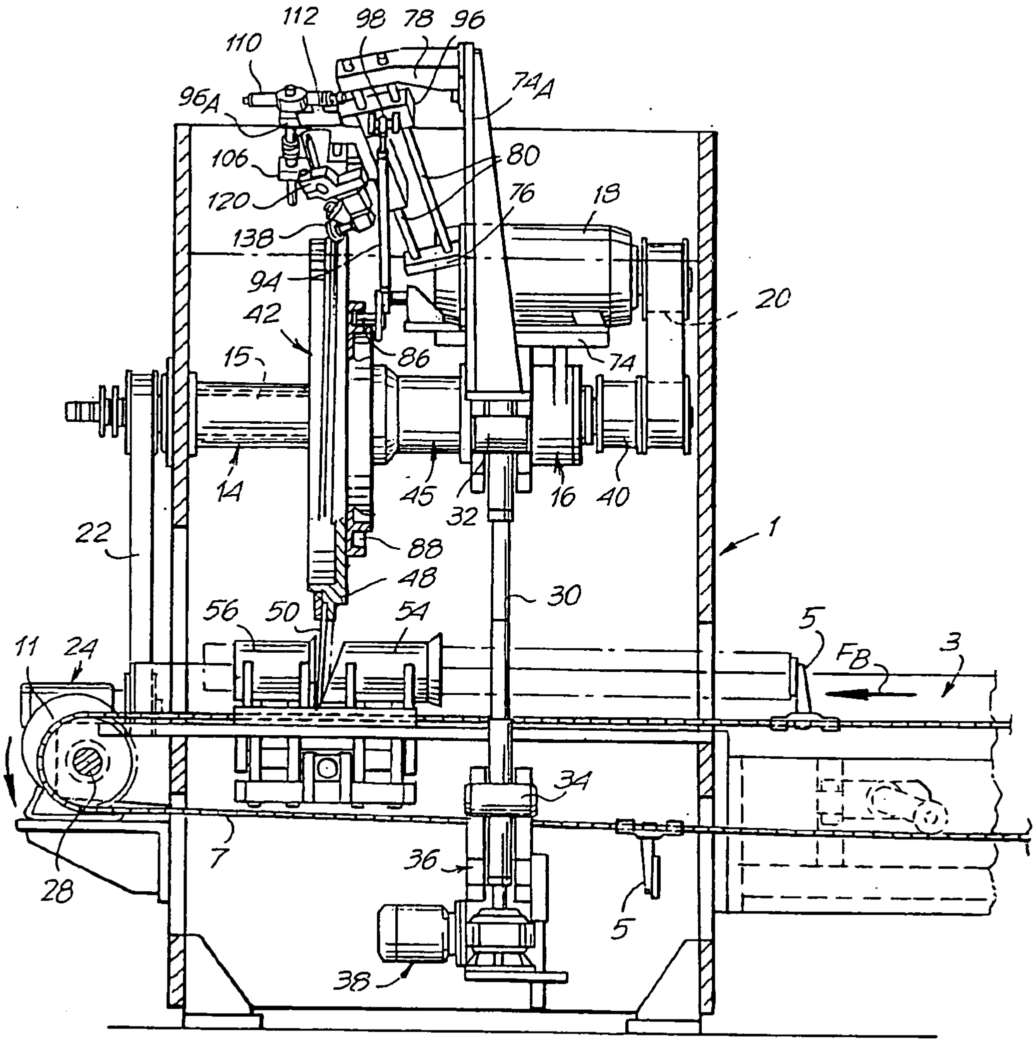

112
98
78
96
110
96A
74A
106
80
120
76
18
138
94
20
42
86
15
74
14
45
32
16
40
22
88
1
48
30
56
50
54
5
11
24
FB
3
34
7
36
28
5
38

Fig. 4

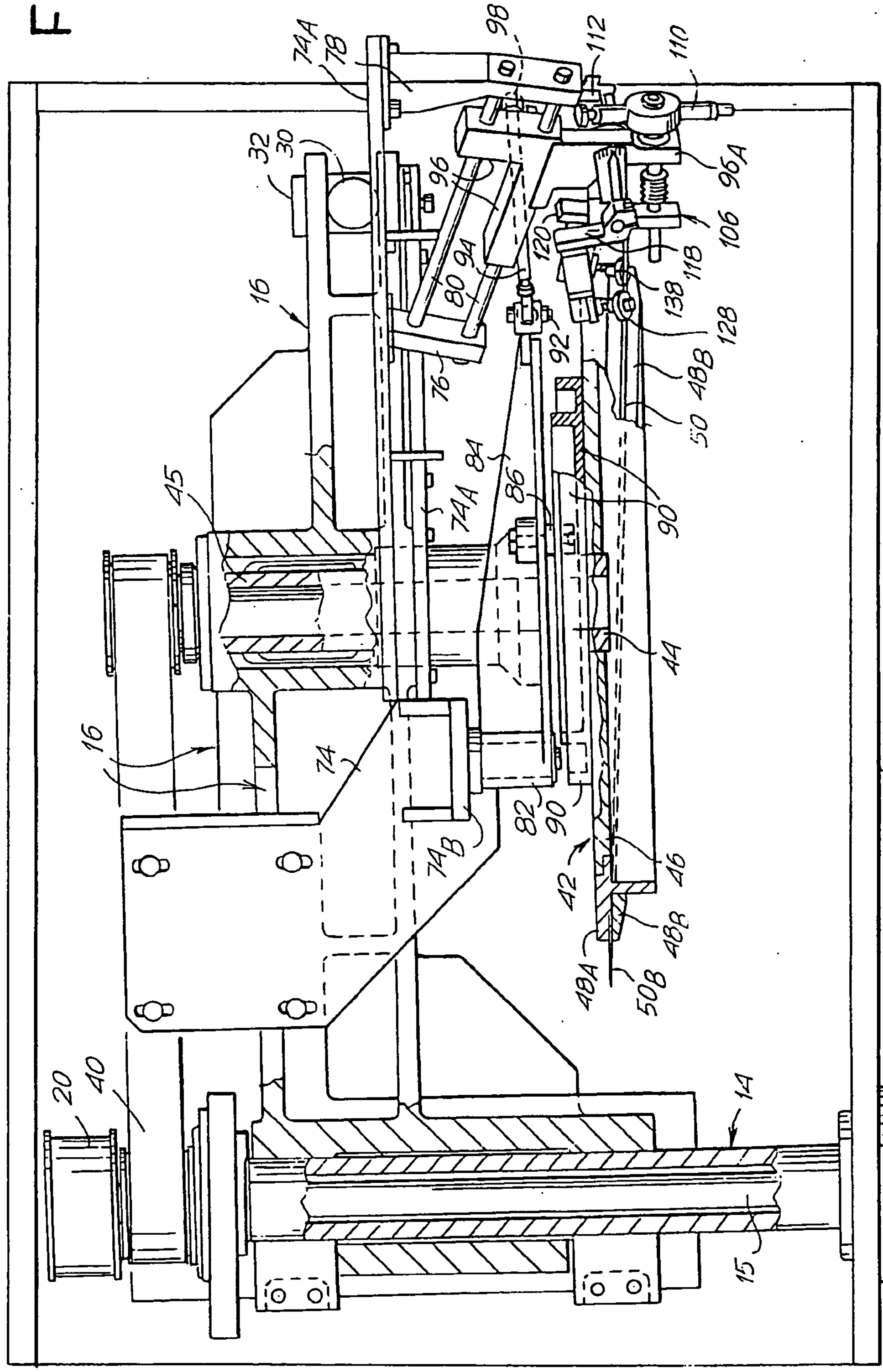
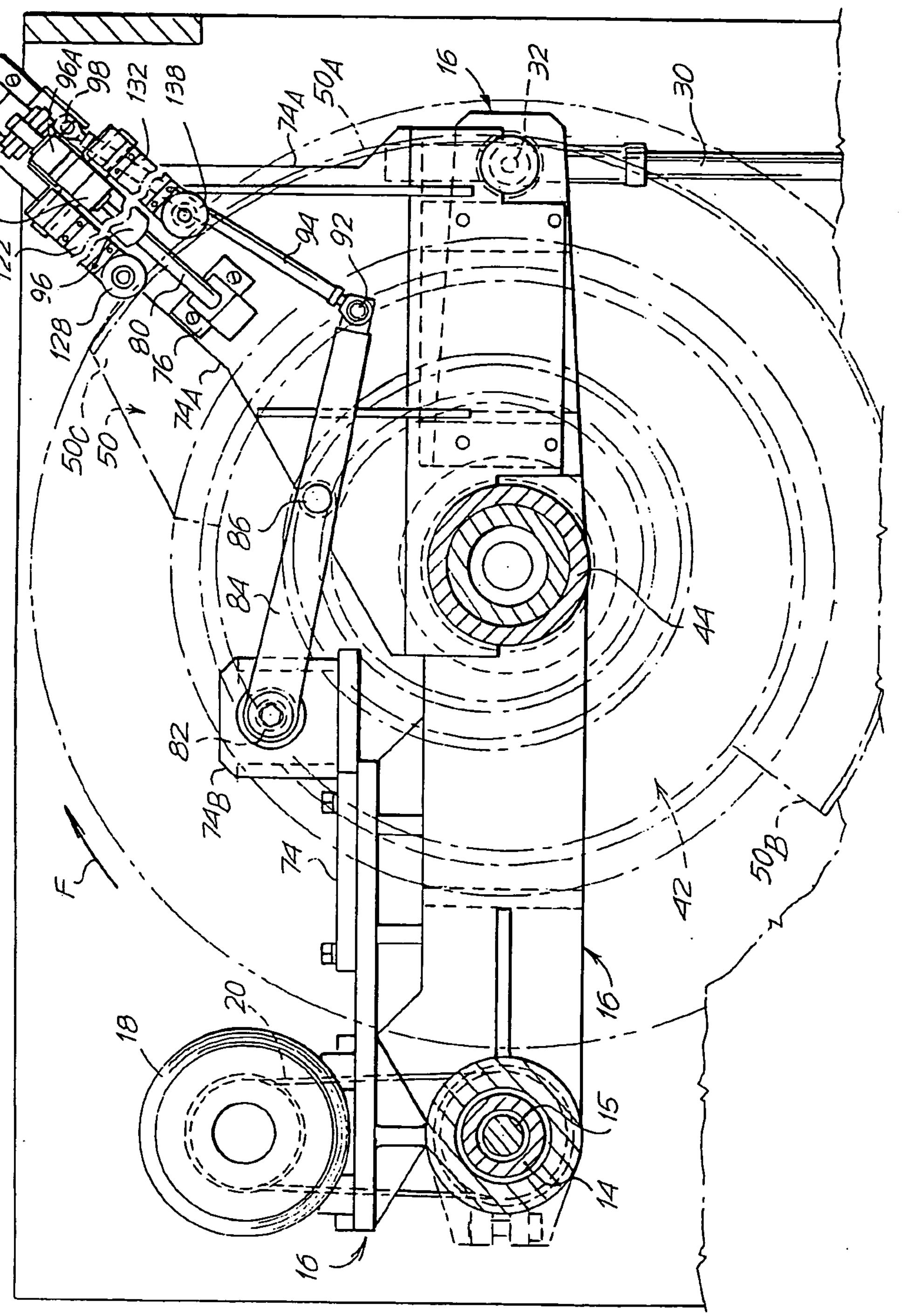

74A
78
98
112
110
32
30
96
96A
106
118
120
94
80
138
128
16
76
92
48B
50
84
86
74A
90
45
44
16
74
82
90
74B
42
46
48A
48B
50B
1
20
40
14
22
15

Fig.5


16
32
30
50A
74A
138
132
98
96A
78
106
122
96
128
80
76
74A
94
92
50C
50
86
84
44
82
74B
74
42
50B
F
20
18
16
15
14
16

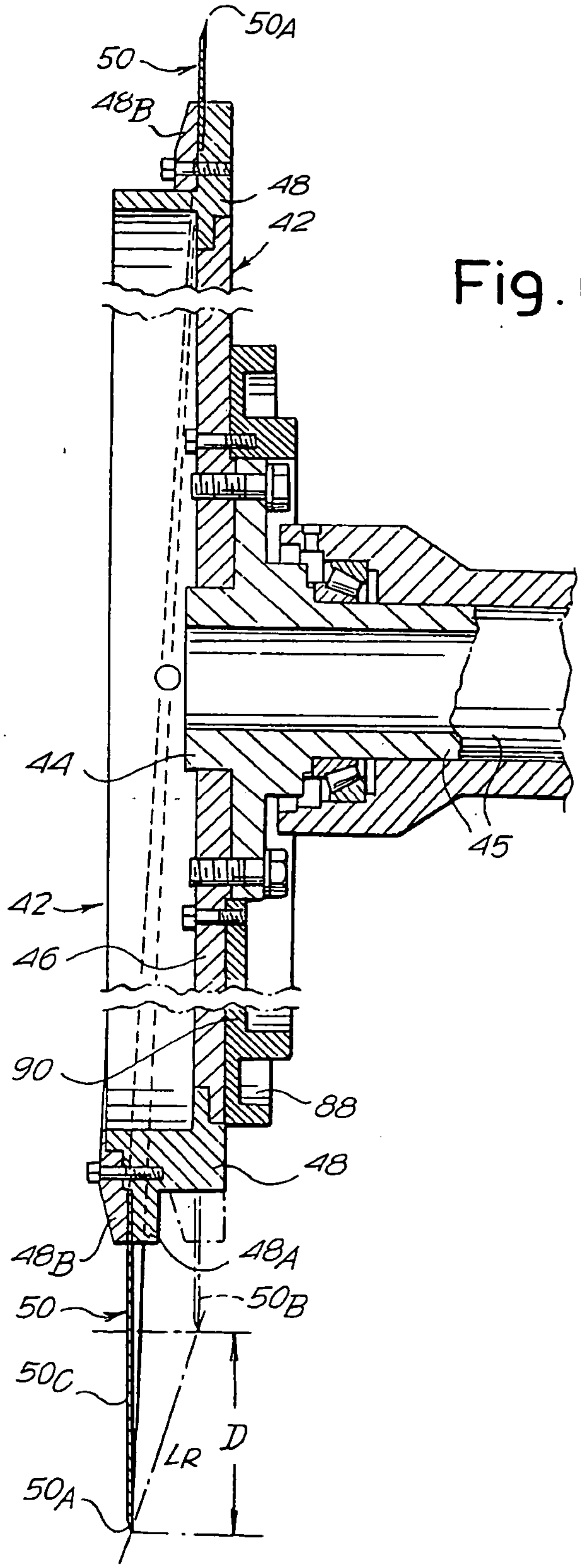


Fig. 6

Fig.7

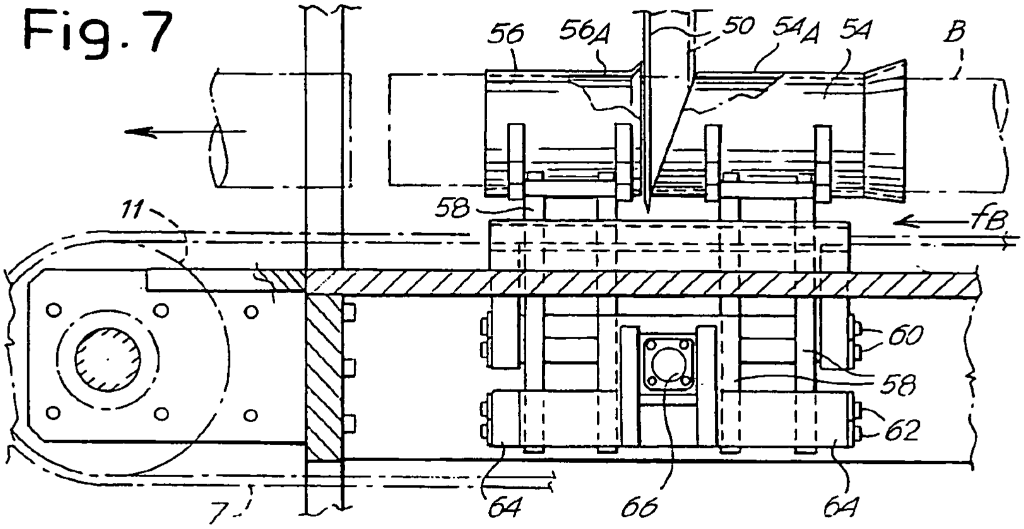


Fig.8

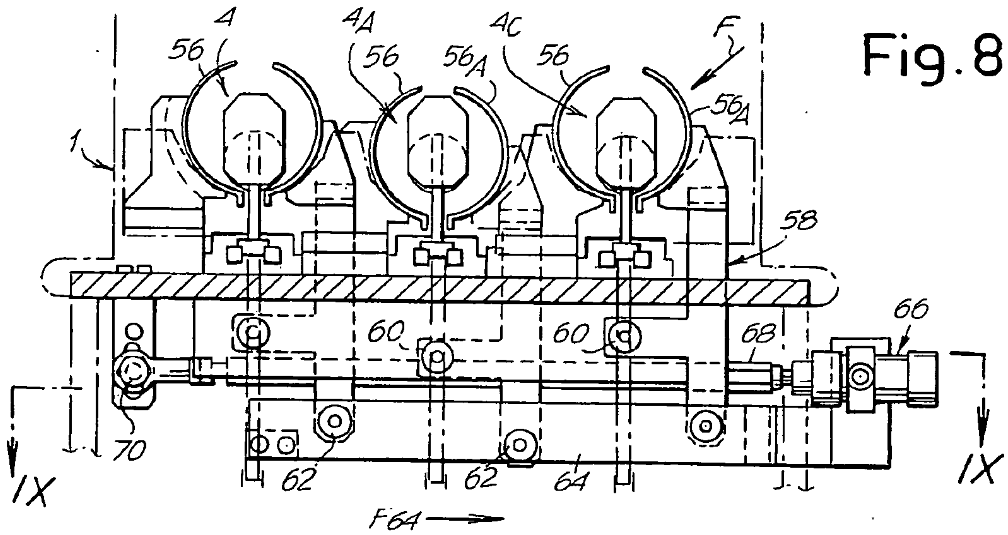
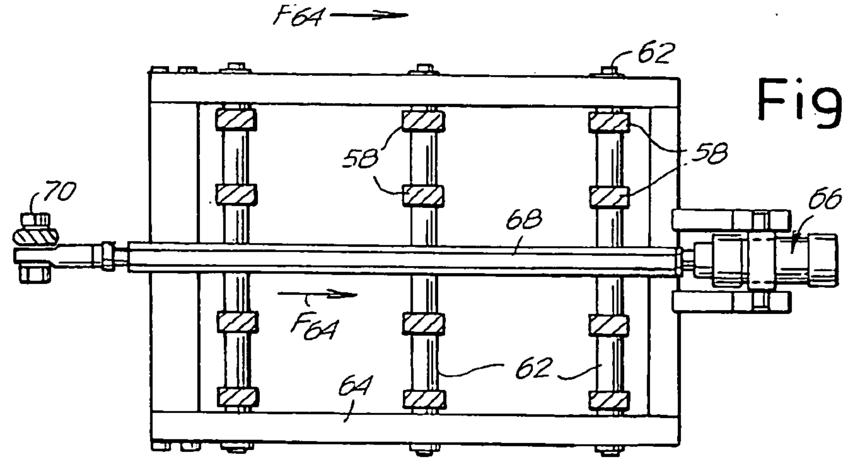


Fig.9



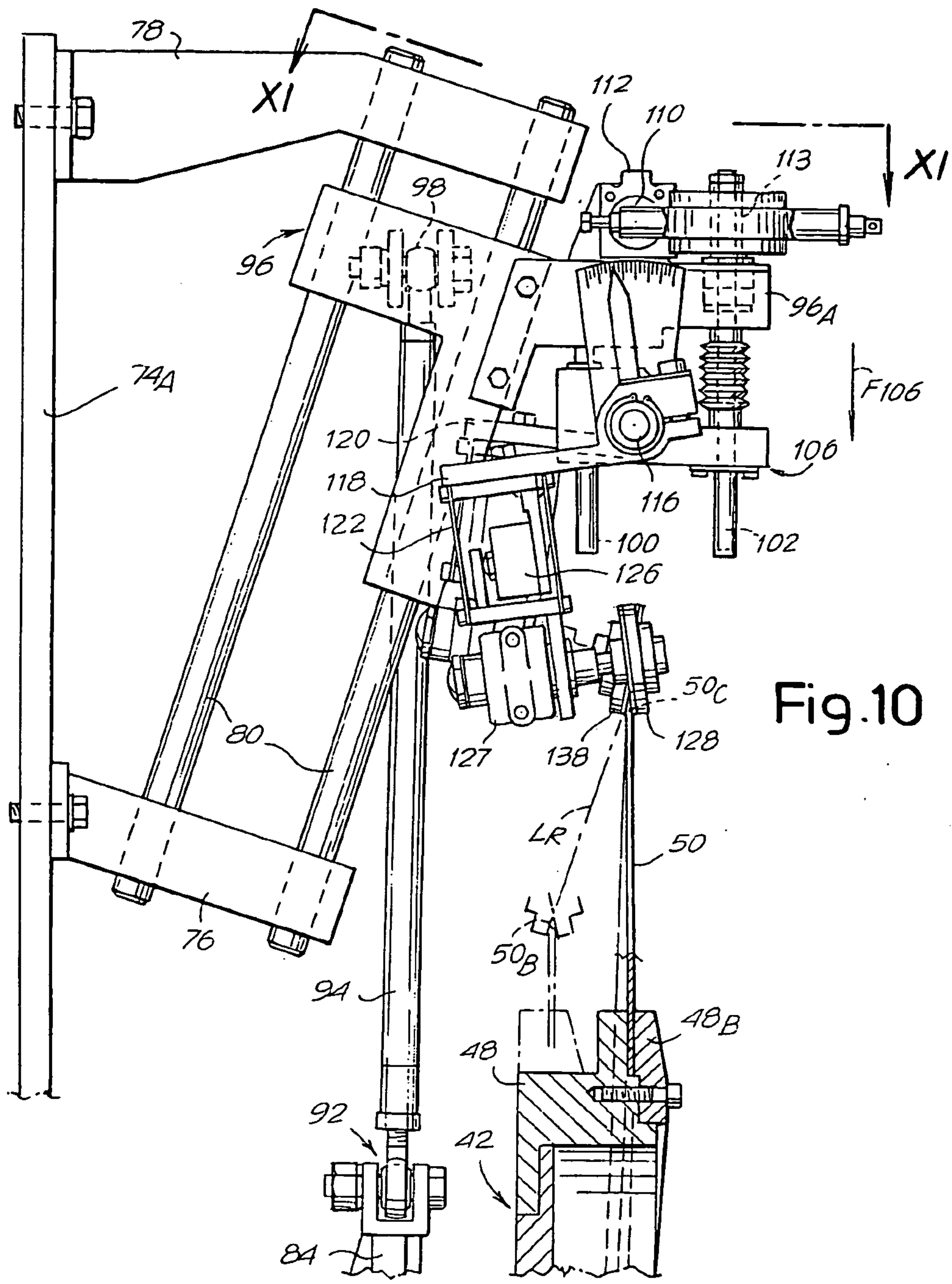

78
XI
112
110
113
XI
98
96
96A
74A
F106
120
106
118
116
122
100
102
126
50C
127
138
128
80
LR
50
50B
76
94
48B
48
92
42
84

Fig.10

Fig.11

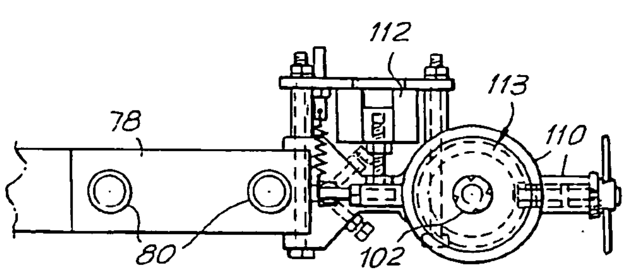
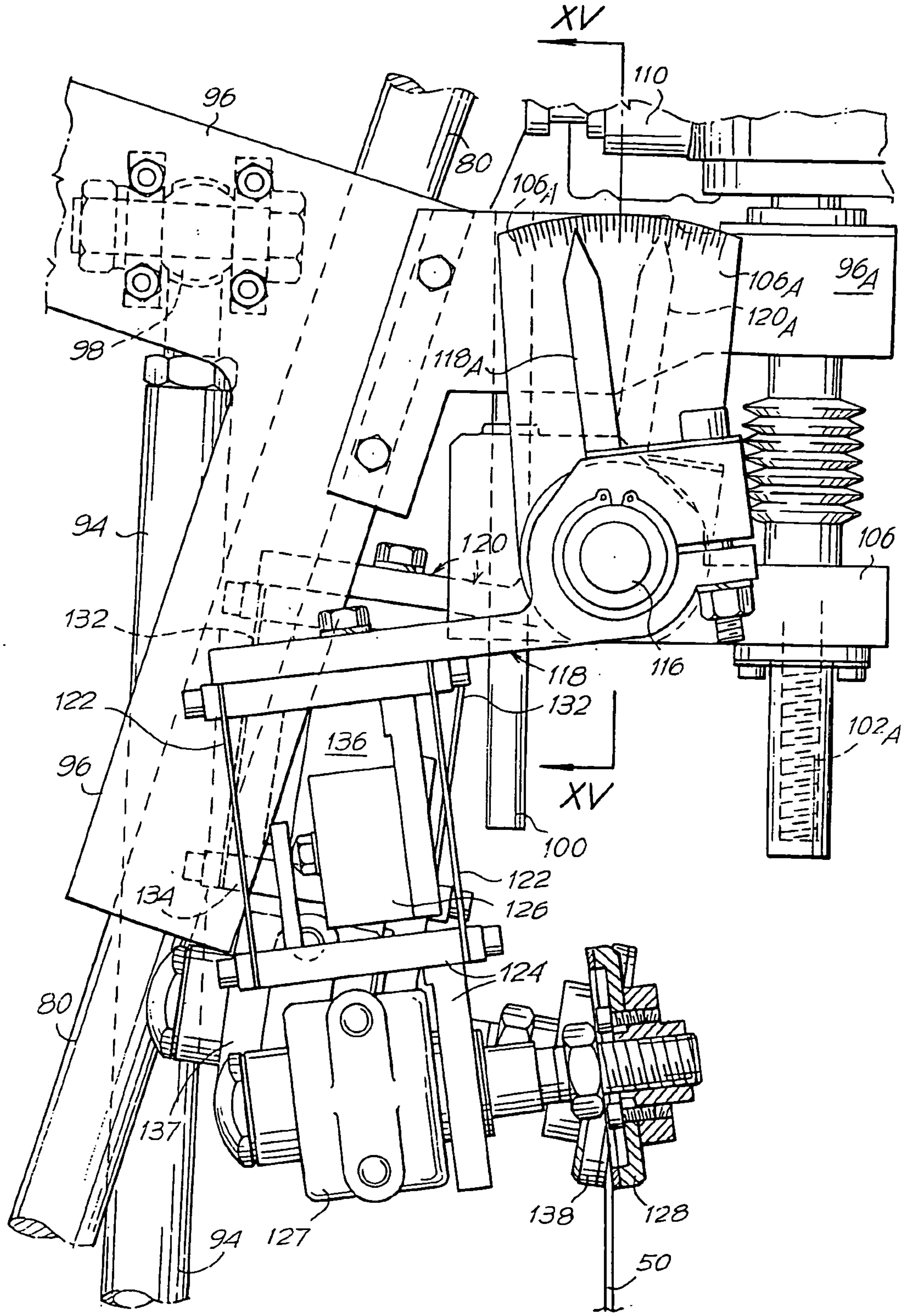

112
113
78
110
80
102

Fig.12


XV
110
96
80
106A
106A
96A
120A
118A
98
94
120
106
132
116
118
122
132
102A
136
96
XV
100
122
134
126
124
80
137
138
128
94
127
50

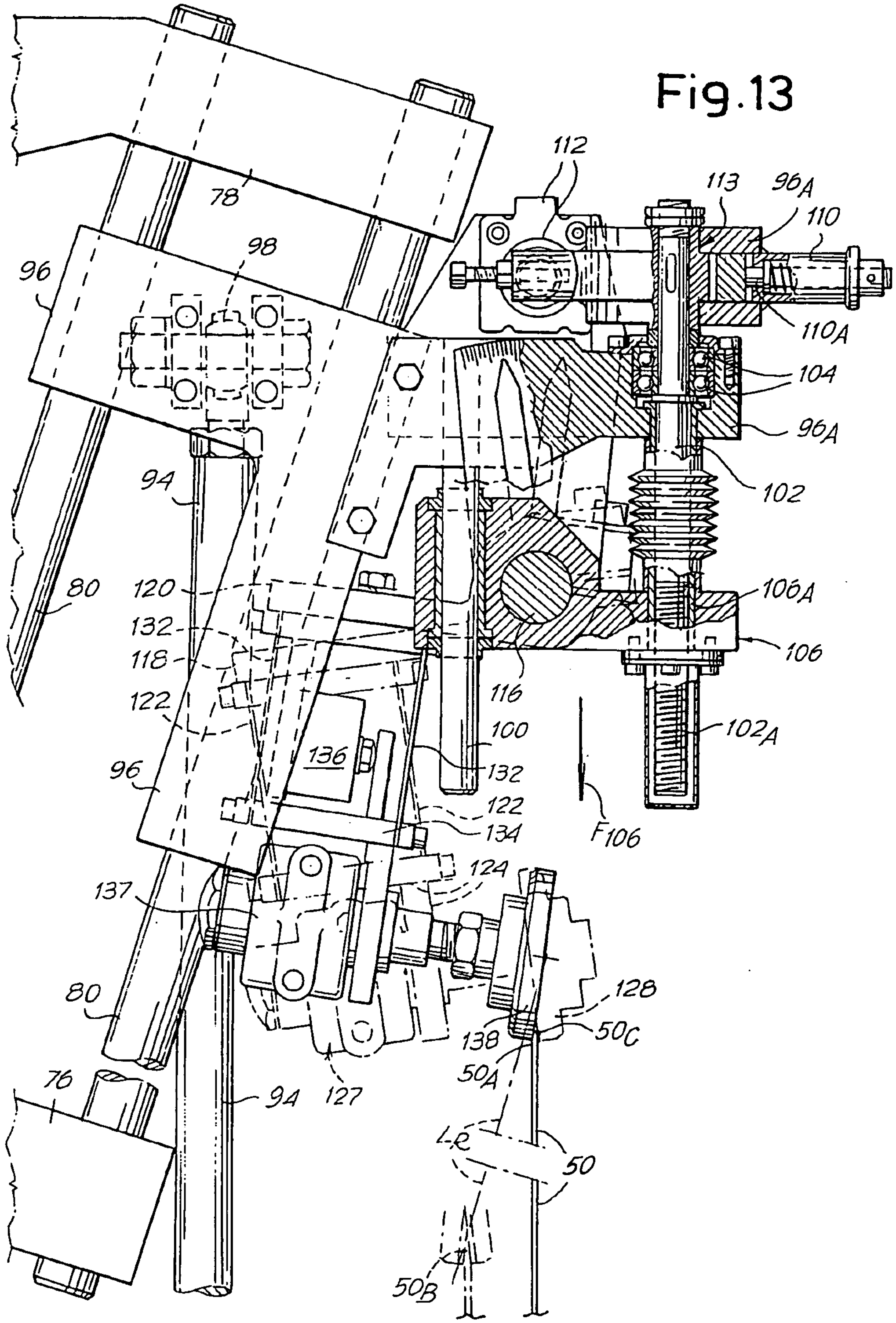

112
113
96A
110
110A
104
96A
102
106A
106
102A
F106
78
98
96
94
80
120
132
118
122
116
100
132
122
134
136
96
124
137
128
80
138
50C
50A
127
76
94
LR
50
50B

Fig.13

Fig.14

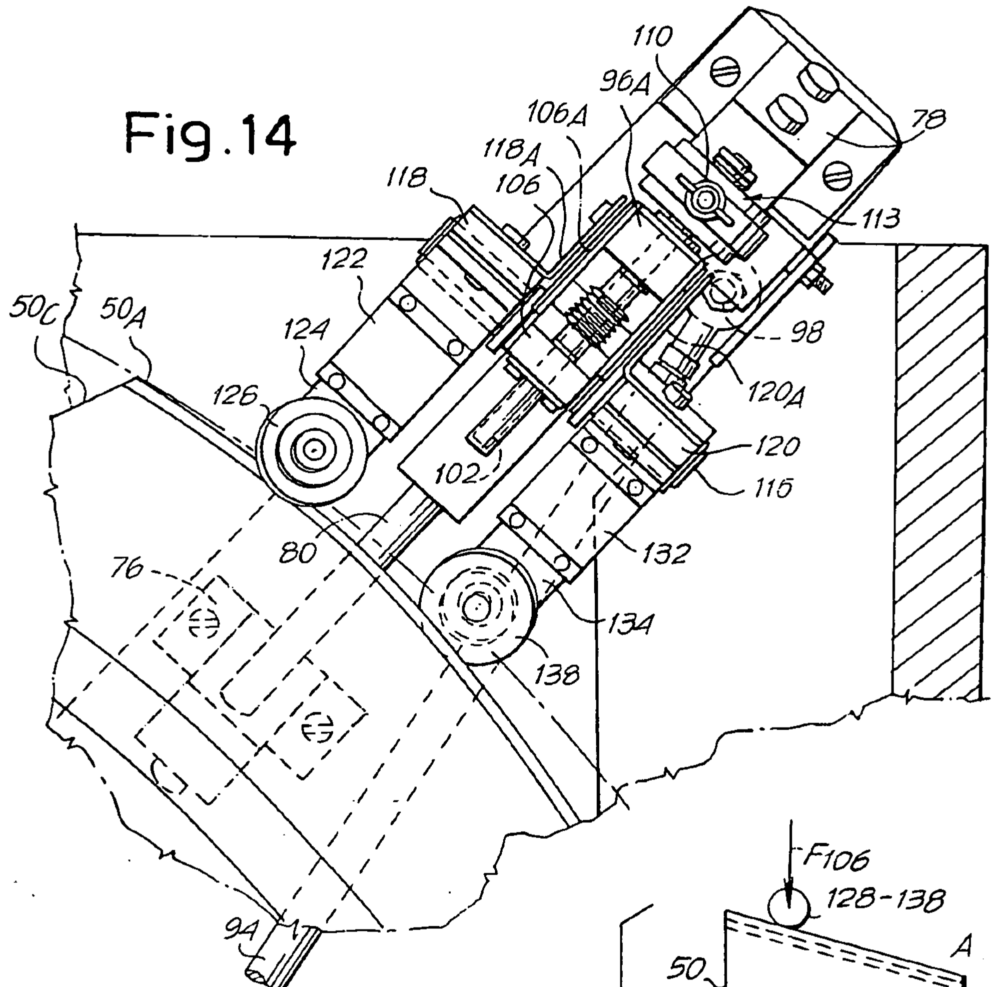
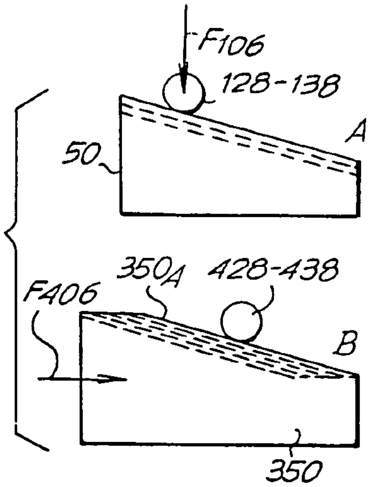


Fig. 16



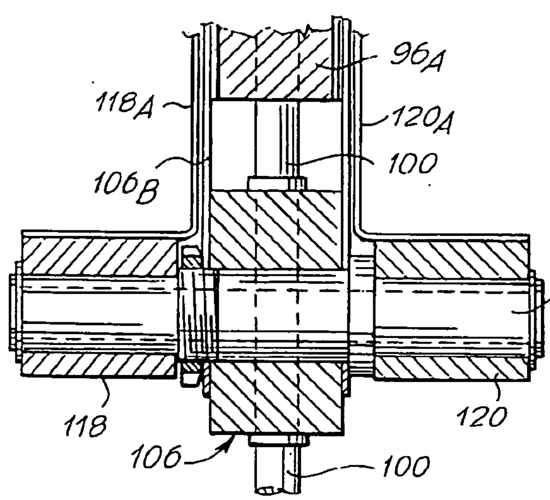


Fig.15

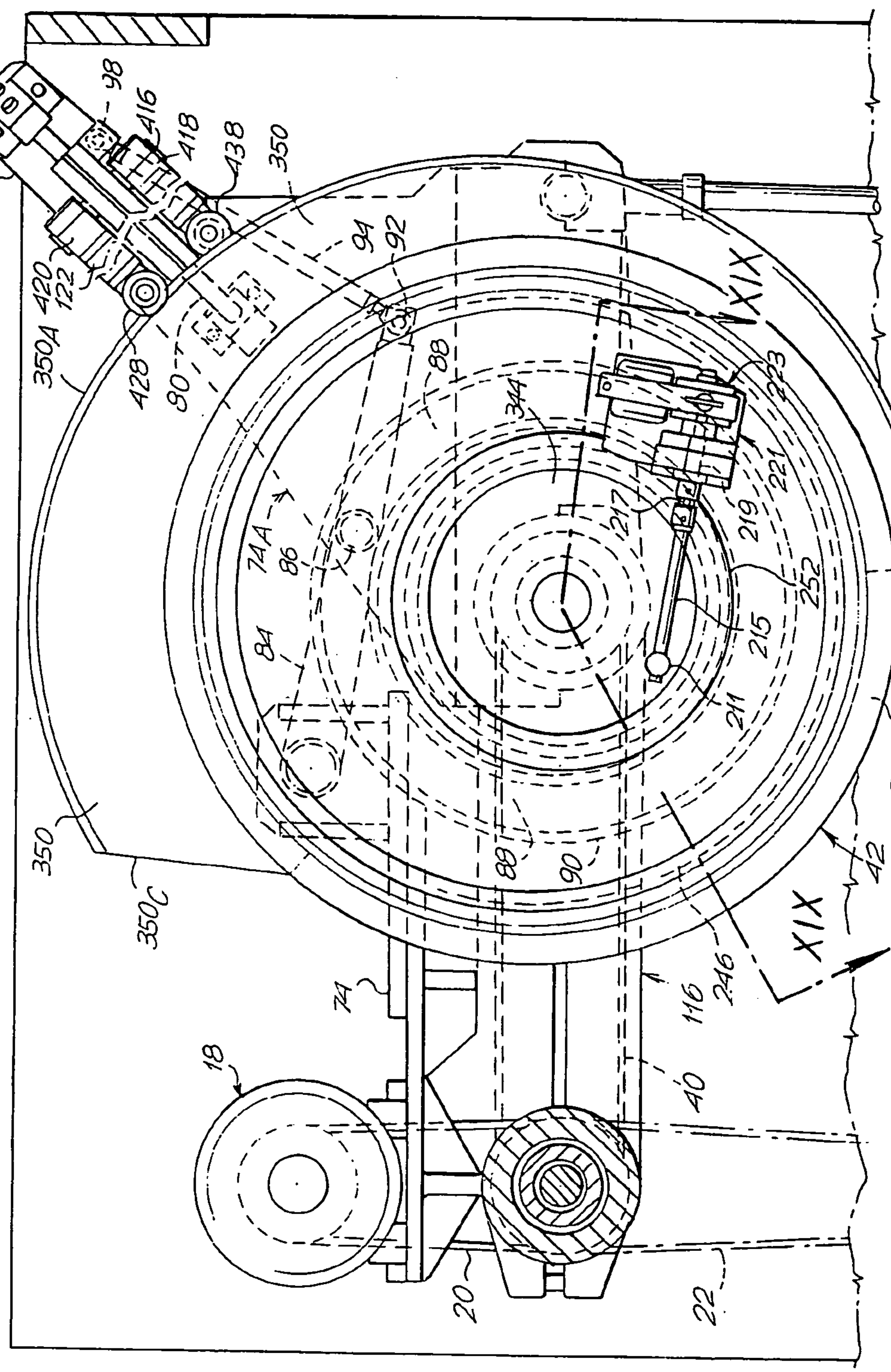
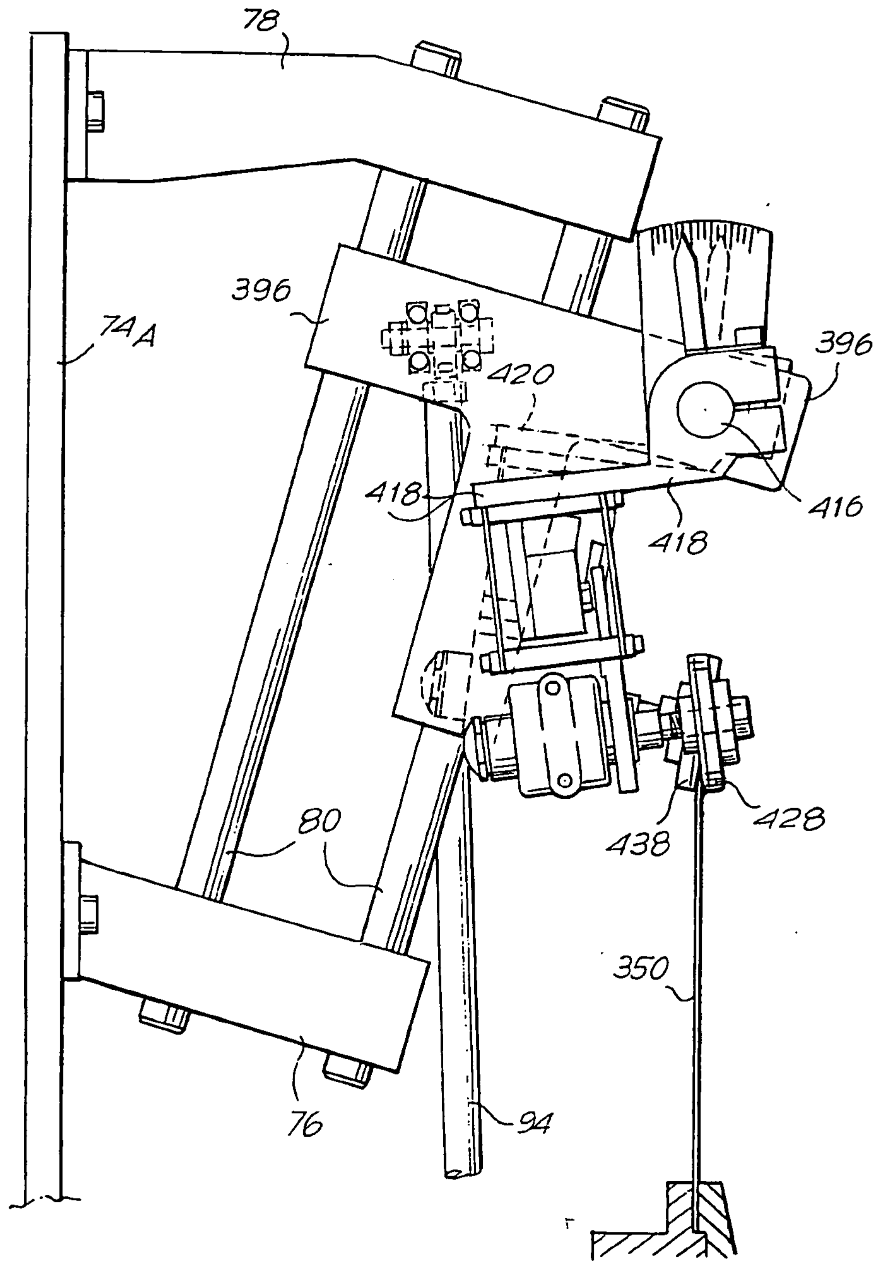

78
74A
98
416
418
438
350
94
92
420
122
350A
428
80
88
344
223
221
219
217
74A
86
84
252
215
211
350B
340B
350
350C
88
90
42
XIX
XIX
74
18
116
246
40
20
22

Fig.17

Fig.18



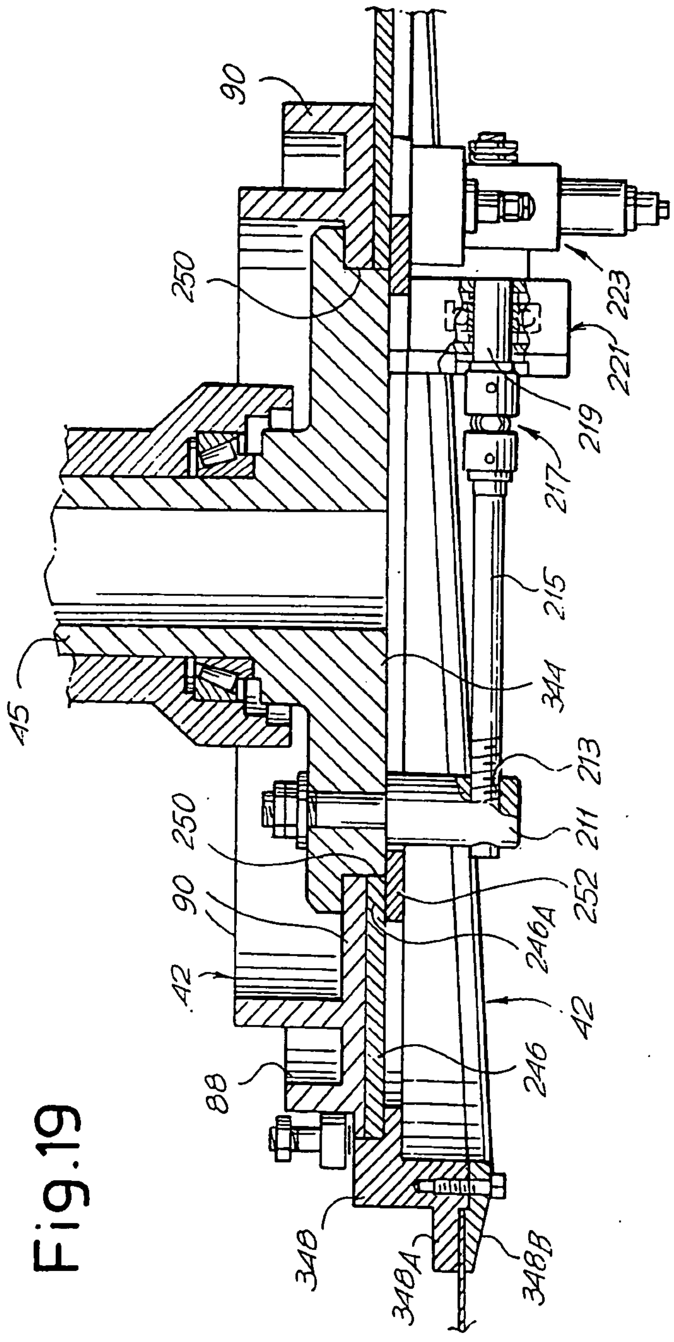

90
250
223
221
219
217
215
344
213
211
252
246A
42
246
348B
348A
348
88
42
90
250
45

Fig.19